WHAT IS CLAIMED IS:

1. A method of determining characteristic X-ray emission data from a certain volume of a certain interconnect structure in a sample, the method comprising:

directing an electron beam towards the surface of the sample to thereby generate X-rays emitted from the volume of the interconnect structure in the sample;

detecting the X-rays emitted from the sample; and

characterizing the distribution and characteristics of one or more voids in the interconnect structure based on the detected X-rays.

2. A method as recited in claim 1, wherein the characterization of the void or voids comprises determining the presence of one or more voids and determining the position or distribution of the void or voids with respect to the interconnect structure when one or more voids are present.

3. A method as recited in claim 1, wherein the sample is a semiconductor device.

4. A method as recited in claim 3, wherein the interconnect structure in the semiconductor device includes at least copper.

5. A method as recited in claim 4, wherein the copper containing interconnect structure in the semiconductor device is at least partially surrounded by dielectric material.

6. A method as recited in claim 4, wherein the detected X-rays are at least copper $K\alpha$ and copper $L\alpha$ X-rays.

7. A method as recited in claim 5, wherein the detected X-rays are at least copper $K\alpha$, copper $L\alpha$ and silicon $K\alpha$ X-rays.

8. A method as recited in claim 1, wherein X-ray emission data is collected from a plurality of similar volumes of similar interconnect structures and statistical data is calculated to determine similar X-ray emission characteristics between the similar volumes of similar interconnect structures.

9. A method as recited in claim 8, wherein X-ray emission data is collected from a plurality of similar volumes of similar interconnect structures in the same sample.

10. A method as recited in claim 8, wherein X-ray emission data is collected from a plurality of similar volumes of similar interconnect structures in different samples.

11. A method as recited in claim 1, wherein the electron beam is focused to a spot size small enough for resolving structures of interest within the sample.

12. A method as recited in claim 11, wherein the electron beam has an energy greater than about 15 keV.

13. A method as recited in claim 11, wherein the electron beam is rastered over an area of the sample surface.

14. A method as recited in claim 1, wherein the volume is a teardrop shaped.

15. A method as recited in claim 1, wherein the volume includes at least a portion of a metal via type structure.

16. A method as recited in claim 1, wherein the volume includes at least a portion of a metal line structure.

17. A method of facilitating the determination of the void characteristics within a conductive interconnect structure of a semiconductor device, the method comprising:

directing a beam toward a first volume that is at least partially within a first interconnect structure of a first sample containing substantially no voids, to thereby cause the first volume to emit X-rays from the first sample;

directing a beam toward a second volume that is at least partially within a second interconnect structure of a second sample containing voids with known void characteristics, to thereby cause the second volume to emit characteristic X-rays from the second sample;

directing a beam toward a third volume that is at least partially within a third interconnect structure of a third sample with unknown void characteristics, to thereby cause

the third volume to emit characteristic X-rays from the third sample, wherein the first, second and third volumes are substantially equal; and

determining the void characteristics in the third interconnect structure in the third sample based on a comparison of the X-rays emitted from the first, second, and third samples.

18. A method as recited in claim 17, wherein the void characteristics comprise the location, size, shape and distribution of the void or voids with respect to the interconnect structure.

19. A method as recited in claim 17, wherein determining the void characteristics of the third sample include determining a quality of the X-rays emitted from the third sample.

20. A method as recited in claim 19, further comprising reporting that the X-ray emitted from the third sample is unacceptable and halting further characterization of voids of the third sample when the quality of the X-rays emitted from the third sample are determined to be unacceptable.

21. A method as recited in claim 17, wherein determining the void characteristics involve measuring the process variations of the first, second and third samples.

22. A method as recited in claim 17, wherein determining the void characteristics of the third sample includes determining whether one or more voids are present within the third sample.

23. A method as recited in claim 17, wherein X-ray data from a plurality of samples containing substantially no voids are collected so that statistical data can be calculated to determine similar X-ray emission characteristics of samples containing substantially no voids, to be compared to data from the sample with known void characteristics and the sample with unknown void characteristics.

24. A method as recited in claim 17, wherein X-ray data from a plurality of samples containing known void characteristics are collected so that statistical data can be calculated to determine similar X-ray emission characteristics of samples containing known void characteristics, to be compared to data from the sample containing substantially no voids and the sample with unknown void characteristics.

25. A method as recited in claim 24, wherein X-ray data from a plurality of samples containing substantially no voids are collected so that statistical data can be calculated to determine similar X-ray emission characteristics of samples containing substantially no voids, to be compared to statistical data from the samples with known void characteristics and the sample with unknown void characteristics.

26. A method as recited in claim 23, wherein the statistical data are the mean, standard deviation, absolute value and ratios of the different X-ray intensities.

27. A method as recited in claim 24, wherein the statistical data are the mean, standard deviation, absolute value and ratios of the different X-ray intensities.

28. A method as recited in claim 25, wherein the statistical data are the mean, standard deviation, absolute value and ratios of the different X-ray intensities.

29. A method as recited in claim 17, wherein the interconnect structure includes at least copper.

30. A method as recited in claim 17, wherein the copper containing interconnect structure is at least partially surrounded by dielectric material.

31. A method as recited in claim 29, wherein the detected X-rays are at least copper Kα and copper Lα X-rays.

32. A method as recited in claim 31, wherein various combinations of ratios of the detected copper Kα and copper Lα X-rays are used to determine the location of voids within the interconnect structure in the third sample.

33. A method as recited in claim 30, wherein the detected X-rays are at least copper Kα, copper Lα and silicon Kα X-rays.

34. A method as recited in claim 33, wherein various combinations of ratios of the detected copper Kα copper Lα X-rays, and silicon Kα X-rays are used to determine the location of voids within the interconnect structure in the third sample.

35. A method as recited in claim 18, wherein the directed beam for the first, second and third samples is an electron beam.

36. A method as recited in claim 35, wherein the electron beam is focused to a spot size small enough for resolving structures of interest within the sample.

37. A method as recited in claim 36, wherein the electron beam has an energy greater than about 15 keV.

38. A method as recited in claim 37, wherein the electron beam is rastered over an area of the sample surface.

39. A method as recited in claim 17, wherein the directed beam for the first, second and third samples is a focused ion beam.

40. An apparatus for characterizing a void within an interconnect structure of a semiconductor device, comprising:

a beam generator operable to direct a charged particle beam towards a structure;

a detector positioned to detect X-rays from the structure in response to the charged particle beam; and

a processor operable to:

cause the beam generator to direct a beam towards the structure; and

characterize one or more voids of the volume of the interconnect structure based on the detected X-rays.

41. An apparatus as recited in claim 40, wherein the characterizing operation is based on a ratio of a first X-ray intensity for a first material over a second X-ray intensity for a second material, wherein the first and second X-ray intensities are obtained from the detected X-rays from the scanned structure.

42. An apparatus as recited in claim 40, wherein the scanned structure is a portion of a interconnect structure in an integrated circuit device.

43. An apparatus as recited in claim 40, wherein the directed beam is an electron beam.

44. An apparatus as recited in claim 43, wherein the electron beam is focused to a spot size small enough for resolving structures of interest within the sample.

45. An apparatus as recited in claim 44, wherein the electron beam has an energy greater than about 15 keV.

46. An apparatus as recited in claim 45, wherein the electron beam is rastered over an area of the sample surface.

47. An apparatus as recited in claim 40, wherein the directed beam for the first, second and third samples is a focused ion beam.

48. An apparatus as recited in claim 40, wherein the processor is further operable to:

cause the beam generator to scan a beam over a reference portion of an interconnect structure, and

wherein a void is characterized by comparing the first ratio from the scanned first via or contact to a second ratio from the scanned reference via, wherein the second ratio is a third X-ray intensity for the first material over a fourth X-ray intensity for the second material, wherein the third and fourth X-ray intensities are obtained from X-rays detected from the scanned reference portion of interconnect structure.

49. An apparatus as recited in claim 40, wherein the processor is further operable to locate the void or voids based on the ratio of the first X-ray intensity for the first material over the second X-ray intensity for the second material.

50. An apparatus as recited in claim 40, wherein the processor is further operable to:

cause the beam generator to scan a beam over a plurality of second portions of interconnect structures, and

wherein characterizing the void or voids of the first portion of interconnect structure is accomplished by determining whether the first ratio from the scanned first portion of interconnect structure significantly differs from a majority of second ratios calculated for the second portions of interconnect structures, wherein the second ratios of the plurality of portions of interconnect structures are each calculated by dividing a third X-ray intensity for the first material by a fourth X-ray intensity for the second material, wherein the third and fourth X-ray intensities are obtained from X-rays detected from each of the scanned second portions of interconnect structures.

51. An apparatus as recited in claim 40, wherein the first and second X-ray intensity are X-ray count values.

52. An apparatus as recited in claim 40, further comprising reporting that the X-ray emitted from the third sample is unacceptable and halting further characterization of voids of the third sample when the quality of the X-rays emitted from the third sample are determined to be unacceptable.